

EXECUTIVE SUMMARY

Air quality was monitored in the Capital Regional District (CRD) to assess the impact of solid waste burning and ambient air quality and to track trends in air quality. The monitoring was conducted under the Long Term Monitoring Program (LTMP), which was a partnership between the CRD and the British Columbia Ministry of the Environment (MoE), Royal Roads University and Environment Canada. The LTMP has been cancelled, and the 2009 annual report is the last one planned to be released by the CRD. SENES Consultants Limited (SENES) was contracted to provide an analysis and summary report of the monitoring data collected in 2009, including analysis of supporting meteorological information that was available over the same time period.

Ambient air concentrations of six air contaminants, collectively referred to as common air contaminants (CACs), are sampled on a frequent basis at the monitoring stations. The six CACs are carbon monoxide (CO), nitrogen dioxide (NO₂), sulphur dioxide (SO₂), ground-level ozone (O₃), particulate matter smaller than or equal to 10 microns (PM₁₀) and particulate matter smaller than or equal to 2.5 microns (PM_{2.5}).

In 2009, there were four air quality stations in the CRD that measured either gaseous contaminants and/or fine particulate matter. One station, on Saturna Island, is managed by Environment Canada, and records only gaseous pollutants. In previous years there were six continuous monitoring stations; however, monitoring was discontinued at Royal Roads University and Christopher Point stations in December 2008. In addition, carbon monoxide monitoring was discontinued at both Stellys and Langford in 2009, and all air quality monitoring at the Stellys Cross Roads site in Central Saanich was discontinued as of March 31, 2010. In addition, three 'Hi-Vol' sites that measured fine particulate matter were also discontinued at the end of 2008.

In addition to the fixed monitoring locations, the B.C. Ministry of the Environment's Mobile Air Monitoring Laboratory (MAML) conducted air quality sampling in the James Bay community from May 30th to August 24th, 2009. The MAML sampling was conducted in support of the James Bay Air Quality Study (JBAQS). Data analysis was prepared by the University of Victoria for the Vancouver Island Health Authority (VIHA) and the Ministry of the Environment.

Overall, data collection was more successful for 2009 than in previous years (i.e., 2007 and 2008) for most contaminants. Note that both ozone and sulphur dioxide data were collected by Environment Canada at the Saturna Island monitoring site through to the end of 2009, but sulphur dioxide data beyond 2007 has not yet been released for use and as such was not included in this report.

A primary focus of the annual air quality report was to assess the annual monitoring data with a set of CRD ambient air quality guidelines that were developed in 2004. In addition, comparisons to provincial and federal objectives and standards were made. Further temporal and spatial analyses were completed to examine trends in community air concentrations and to establish potential links between ambient concentrations and emission sources.

For the vast majority of the time in 2009, air quality remained good in the CRD. The CRD guideline for PM_{2.5} was exceeded once at Stellys station and once at Victoria Topaz station on a separate day. The CRD ozone guideline was also exceeded once at Stellys station.

- The exceedance of the PM_{2.5} guideline of 25 µg/m³ occurred once at the Stellys monitoring station on November 1st, with a 24-hour average concentration of 29.9 µg/m³, based on the continuous TEOM sampler. Concentrations recorded at each of the other PM_{2.5} monitoring stations in the CRD on that date were much lower, indicating that the higher PM_{2.5} concentration at Stellys was not experienced throughout a large portion of the CRD. The likely cause of the high concentration at the Stellys site on this date could not be determined, however high PM_{2.5} readings in the CRD have been previously (e.g., Victoria Topaz in 2003) noted in association with fireworks on Halloween and it is possible (even likely) that this occurrence at Stellys was similarly related to this holiday.
- The PM_{2.5} guideline was also slightly exceeded on December 9th at the Victoria Topaz monitoring station, with a 24-hour average concentration of 26.3 µg/m³ based on the sequential Dichotomous (Dichot) sampler. The co-located continuous TEOM sampler recorded a PM_{2.5} concentration on that date was 18.4 µg/m³. TEOM samplers are recognized to have some loss of sample in colder seasons, and it is likely that the Dichot sampler provided a more reliable sample of PM_{2.5} concentration on that date, and that the CRD guideline was indeed exceeded. The guideline was not exceeded at Stellys station on this date. Data for Langford station was unavailable. The likely cause of the high concentration at the Topaz site on this date could not be determined.
- The maximum 8-hour rolling average ozone concentration at Stellys station of 122 µg/m³ on July 29th exceeded the CRD guideline value of 120 µg/m³. The ozone episode was also observed at Langford and Saturna Island stations, and was associated with the issuance of an Air Quality Advisory by the Ministry of the Environment. The pattern of increased ozone concentrations in the afternoon hours of a summer day suggests the influence of photochemical production of O₃ on this occasion at all stations. Unlike past monitoring years, the exceedance of the CRD guideline occurred at Stellys station rather than Saturna Island. However, higher ozone levels at Saturna Island persisted well into the evening hours whereas levels at Stellys and Langford quickly dropped in late afternoon, mirroring the ozone episodes that occurred in both May 2007 and 2008. The

anticipated exceedance of the Provincial Ambient Air Quality Objective of $160 \mu\text{g}/\text{m}^3$ which triggered the issuance of the air quality advisory did not occur.

Due to the limited temporal and spatial extent of exposure to the $\text{PM}_{2.5}$ and ozone guideline exceedances, related health effects for community members could not be determined with confidence.

Although the CRD remains in attainment of the Canada-Wide Standards (CWS) for both $\text{PM}_{2.5}$ and ozone, there has been a continuous upward trend in 4th highest 8-hour average ozone concentrations at the Stellys site for the period of record (2003-2009). The cessation of all air quality sampling at this location as of March 2010 will preclude any possibility of determining whether or not this trend would continue into the future which could lead to non-attainment of the CWS.

A statistical tool was developed for the CRD in 2006 for the purpose of assessing trends in air quality concentrations over a period of five or more years. The tool assesses whether a statistically significant trend (increase or decrease) in annual mean and 98th percentile concentrations exists over the period. In addition, a trend in the proportion of measurements above the applicable CRD guideline is assessed. Statistically significant trends at the mean and/or 98th percentile level were found for all contaminants except NO_2 . Significant trends were present for CO , $\text{PM}_{2.5}$ and PM_{10} monitoring data at Victoria Topaz over the period 1998-2009, O_3 for the period 2003-2009 at Stellys and SO_2 at Saturna Island for the period 1998-2007. Trends were determined to be as follows:

- a decrease of 4%/year in annual 98th percentile concentrations of CO at Topaz;
- a decrease of 2%/year in the annual mean concentration of $\text{PM}_{2.5}$ at Topaz;
- a decrease of 4%/year in the annual mean concentration of PM_{10} at Topaz;
- a decrease of 5%/year in annual mean concentrations of SO_2 at Saturna Island;
- a decrease of 12%/year in annual 98th percentile concentrations of SO_2 at Saturna Island; and,
- an increase of 3%/year in the annual mean concentration of O_3 Stellys.

It should be noted that the 22% per year increase in ozone concentrations above the CRD guideline at Saturna Island identified in the 2008 annual report is absent from the 2009 trends analysis. If 2010 ozone levels are comparable to 2009 observations, it is expected that the CWS for ground level ozone will not be exceeded at the implementation date of the standard (2010).

Similarly, the significant trend towards lower annual mean and 98th percentile SO_2 concentrations based on 1998-2008 data at Topaz station was not present for the 1998-2009 period due to higher than expected SO_2 concentrations in 2008 and 2009. This suggests that a

shift in the trend may be occurring, although the reasons for such a possible reversal are not clear. In the annual air quality report for the CRD in 2008, cruise ships were identified as contributing to some of the highest peak 1-hour average SO₂ concentrations observed at the Topaz station, and there has been a fairly large increase in cruise ship visits to the Victoria Harbour over the past decade, from a low of 26 visits in 1998 to a total of 201 visits in 2008 and 215 in 2009. While it is possible that the increase in cruise ship visits to Victoria has contributed to the reversal in the trend toward lower SO₂ concentrations at Topaz in 2008 and 2009, this cannot be conclusively determined. In the absence of available SO₂ monitoring data from Saturna Island for 2008 and 2009, it is unclear whether the changes in the long-term SO₂ trends at Topaz represent a change in regional concentrations or a local effect that is limited to the Topaz station alone.

The MAML sampling in support of the JBAQS was specifically established to determine the effects of cruise ship emissions on the James Bay community. The sampling results for 2009 indicated that NO, NO₂ and SO₂ levels were always highest at both the MAML and Topaz monitoring locations on days when cruise ships were in port, as compared with days when cruise ships were not in port. Although no existing Provincial air quality objectives or CRD guidelines were exceeded at these locations during the monitoring period, the recently proposed level for a new 1-hour average SO₂ primary air quality standard in the United States was exceeded approximately 1.5% of the time at the MAML site. In addition, the World Health Organization (WHO) guideline value for 24-hour average SO₂ concentrations was exceeded 16% of the time at the MAML location and 3.5% of the time at the Topaz site. The WHO guideline value for 10-minute average SO₂ concentrations (meant to provide protection against acute exposure to peak SO₂ concentrations), was also exceeded on three occasions during the MAML monitoring period.

In response to the MAML monitoring results and other previous analyses of the impacts of cruise ship emissions on air quality in the CRD, VIHA concluded that there are occasions when the SO₂ levels are sufficiently elevated so as to cause health impacts in some individuals, particularly those with chronic respiratory conditions. These impacts could affect the quality of life and well-being of some area residents, and there is a statistical possibility that, in a worst-case scenario, excess deaths could occur over the course of a year if the adverse health effects from exposure to these pollutants are not properly managed.

In summary, ambient concentrations of the common air contaminants monitored in the CRD remain relatively low compared with all provincial and federal guidelines objectives and standards, and the CRD was in attainment of the Canada Wide Standards (CWS) for ground level ozone and PM_{2.5} in 2009 based on the available data. Overall, the majority of CAC show no strong upward or downward trends over time, with the exception of decreasing trends (1998 to 2007) for sulphur dioxide at the Saturna Island site, and an increasing trend in peak ozone levels at Stellys which, if continued, could eventually exceed the CWS. A small decrease in carbon

monoxide, PM_{2.5} and PM₁₀ is present at the Topaz site only. There is also a small increasing trend in the mean annual ozone concentration at Stellys station and ozone levels appear to be approaching the CRD guideline. However, there is also evidence that SO₂ concentrations from time-to-time do exceed existing or proposed international standards or guidelines, and reach levels that could adversely affect the health of some residents of the CRD.